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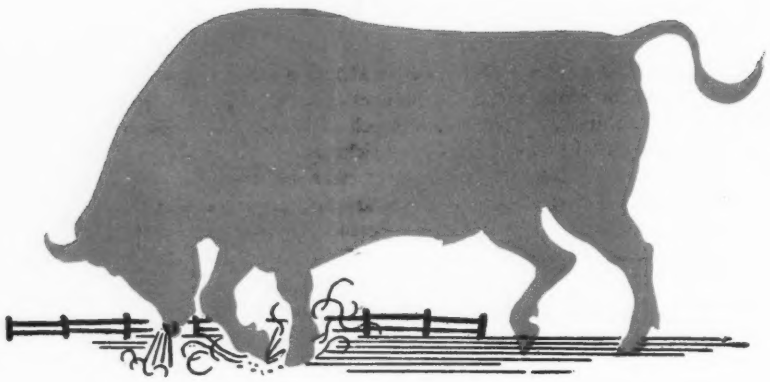
The American FERTILIZER



what's eating him?

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The American FERTILIZER

Vol. 110 JANUARY 8, 1949 No. 1

Minor Elements in Soils and Plants*

By FIRMAN E. BEAR

Head of Soils Department, Rutgers University, New Brunswick, N. J.

THE primary concern of the fertilizer industry is that of supplying N, P, and K in available forms for the purpose of increasing acre yields of crop plants. But considerable amounts of calcium (Ca), sulphur (S), chlorine (Cl) and sodium (Na) are also being applied as necessary carriers of these fertilizer elements. In addition, it is common practice to use pulverized or calcined dolomite in formulating complete mixtures, and they supply magnesium (Mg). More recently considerable areas of land have been found to be deficient in boron (B), manganese (Mn), zinc (Zn) and copper (Cu), and these elements are now being added to fertilizers. For the purpose of this paper, the carrier group of accessory elements will be labeled secondary, and the others minor.

Secondary as well as minor elements have been shown to have value for increasing crop yields. This does not mean that all crops are necessarily benefited by all of them or that all soils tend to be deficient in all of them. But the evidence shows that many soils contain only very limited amounts of one or more of the elements included in these two groups. It also indicates that every one of these elements has value for increasing acre yields of at least several important farm crops. In other words, each of these secondary and minor elements has been applied to the advantage of at least several different crops growing on at least several different soils.

All the minor elements mentioned are now being applied to soils in the form of one or another of their compounds. In some cases, the dry salts are used separately and, in others, as part of a complete fertilizer. In still other cases, the elements are applied in spray form, either separately or in conjunction with insecticides and fungicides.

From time to time, additions are being made to the list of minor elements. Thus molybdenum (Mo) is known to be of value to some plants, notably the legumes. The evidence suggests that its primary effect is on the nodule bacteria. Iodine (I) and cobalt (Co) are sometimes applied to pastureland, but primarily for their possible value to the consuming livestock rather than for any known benefit to the grass and clover. We are now subjecting 15 samples of alfalfa to analysis for more than 30 minor elements that are under suspicion as being possible limiting factors in plant or animal growth and well-being.

The need for minor elements is greatest on the lighter coastal-plain soils along the Atlantic Ocean and the Gulf of Mexico. But it is necessary to keep in mind that soils in areas that are far removed from the coast are often found to be deficient in one or more of these elements. It is important also to note that new areas of minor-element deficiency are continually being located. An important

*An address before the Wm. Penn Chapter, Society of Soil Conservation, Upper Darby, Pa.

reason for the increase in the need for these elements is that acre yields are being stepped-up by heavier applications of NPK fertilizer, the use of more lime, the planting of larger acreages of improved hybrids, and the addition of extra water. These higher acre yields increase the minor-element requirements per acre. They also dilute the content of these elements in the crop, oftentimes to the detriment of the animals that consume it.

Much of the popularity of animal manures and composts has its explanation in the great variety of mineral elements which they contain. Animal manures supply missing elements that were derived from feedstuffs which came from areas of production that were far removed from the farm on which the feed was consumed. The compost pile often contains refuse of plants from the four corners of the earth. When all the facts about secondary and minor-element deficiencies and supplies are known, it should be possible to take most of the mystery out of the manure pile. Once this mystery is resolved, inorganic manures of greatly improved quality can be produced. They will have the advantage that they can be exactly reproduced at will.

Work at the New Jersey Station

The Soils Department of the New Jersey Agricultural Experiment Station has done a large amount of work on minor elements in relation to the well-being of crop plants. The most elaborate studies to date have been with B, Mg, and Mn. Major investigations that are now under way involve additional research on Mg and Mn, and new work on Mo and Na. A considerable amount of work is being done with Cu, Zn, Co, F, and I. Use is being made of a radioactive isotope of Na, and studies are expected to be begun soon on radioactive Ca. Finally, some fields tests have been made of radioactive ores, and further work is under consideration in this field. Ten capable graduate students, all candidates for Ph.D. degrees, are now working with one or another or several of these elements.

Our special interest in these elements has arisen because of the location of New Jersey with respect to the Atlantic Coast Plain, which covers about two-thirds of the State. Most of the agricultural land of this area consists of loamy sands, sandy loams, and loams. These soils are characterized not only by the relatively small total quantities of nutrient elements which they contain, but by their limited capacities to retain any soluble forms of these elements, whether they have been derived from the soil itself or have been applied in the form of fertilizers. Since the rainfall of the State approaches 50 inches annually, leaching losses are serious. This statement applies to an even greater degree to the coastal-plain areas of the states farther south, where the rainfall is still heavier.

Location of Markets

Another factor that is involved in determining the need for such studies in New Jersey is its location with respect to large numbers of consumers of agricultural products. Although the state constitutes only about one four-hundredth of the total land area of the United States, it contains and is immediately surrounded by some 14 million people, or about one-tenth of the Nation's population. This means that a ready demand exists for everything the land can produce. Concentration of population in and around New Jersey is the result of a tremendous industrial development. With such industrialization, comes high labor costs. Unless the farmer is a very efficient producer, he cannot compete for labor. Such efficiency calls for heavy expenditures for fertilizers, and often for extra water in order to raise yields and thus to lower the cost per unit of produce. It is apparent that in proportion as yields are thus stepped-up, the need for supplemental applications of the minor nutrient elements is increased.

In highly industrialized areas, the atmosphere often contains gases that are not normally present in the air of regions farther removed from such centers. Some of these gases, such as the ammonia that is released in the burning of coal, have value. Others, such as carbon dioxide, may have little or no supplemental effect on plants or animals. Still others may be injurious to living things. Of this group, the most common example is the sulfur dioxide that is released in large amounts from smelters, and the fluorine (F) that escapes from certain industrial plants.

The practical importance of our findings can perhaps best be understood by giving a few examples. Several years ago, a prominent truck farmer in New Jersey brought some horseradish roots into our laboratory with the complaint that the sauce which was being produced from them was full of black specks that made it unattractive to the trade. On cutting the roots open, it was found that each of them contained a ring of black tissue, about half way between the surface and the center.

Fortunately, we had just completed a com-

prehensive study of the B needs of New Jersey soils and, as a result, had learned to distinguish the symptoms of deficiency of this element on a considerable variety of plants. Although we had seen nothing exactly like the markings on the horseradish roots, our best guess was that the trouble was caused by a lack of B. When the farmer followed our suggestion and applied borax at the rate of 20 pounds per acre, the black rings were completely eliminated.

During World War II, farmers who were located in the direction of the prevailing winds with respect to certain industrial plants which were manufacturing chemicals for warfare purposes complained that the fumes from these plants were injuring their crops and trees. The evidence was quite conclusive and, ultimately, F came under suspicion as being responsible for at least part of the difficulty.

When the trouble reached such proportions that something definite had to be done about it, the owners of the industrial plants found means by which the fumes could be controlled. The question remained, however, as to whether the F that had entered the soil would continue to be injurious to plants, and possibly to the consumers of the edible portions of these plants. Combined greenhouse and laboratory work finally demonstrated that if the pH value of these naturally acid soils was raised to about 6.5, the availability of the F to plants was so reduced that very little was absorbed by them. By the supplemental use of superphosphate, the solubility of the F was still further decreased.

X-disease of Cattle

A few months ago our attention was called to some troubles that were being experienced by a prominent dairyman in the southern part of the State. He had been forced out of business by the loss of a large number of cows and calves by what is known as X-disease of cattle. In the hope of being of some help, our department collected samples of both soils and plants from his farm for laboratory examination. When the reports on these tests became available, nothing of any special significance was noted.

It happened that we were making a preliminary investigation of Mo as a necessary nutrient element for alfalfa. Study of the literature on this element had revealed to us that although Mo is essential to some plants it tends to be toxic to animals. When the Mo content of the several species of plants from this farm was determined, it was found that some of the ladino clover contained 9 parts per million of the element, on the dry-matter basis. Most plants in New Jersey do not contain more than one part per million Mo. As a result of these tests, this element is now definitely under suspicion as being the cause of the dairy farmer's troubles, and further studies involving soils, plants, and animals are under way. This work is being done in cooperation with our dairy department, the State Veterinarian, and the School of Veterinary Medicine of the University of Pennsylvania.

It has long been standard practice to apply lime to naturally acid soils, and such soils are common to humid regions. In the coastal plain areas, it has frequently been noted that lime has a negative effect on crop yields. Various explanations have been offered for this, but the one most commonly accepted is that, at high pH levels, the availability of some of the minor nutrient elements, notably Mn, Zn, Cu, and B, is so reduced as to make their lack a seriously limiting factor in crop growth.

Early in 1948 a prominent farmer called our attention to the very poor growth of alfalfa on his farm, and asked for help. Samples of the soil and plants were brought into the laboratory for examination, but nothing in the chemist's report gave any very definite clue to the difficulty, except that the pH value of the soil was only a little under 7. This suggested that possibly the availability of the soil Mn had been lowered by liming to the point of deficiency. An application of manganese sulfate, at the rate of 50 pounds per acre, brought immediate response and effected an 80-per cent increase in yield of the crop that was harvested some weeks later.

Mineral Content of Vegetables

About a year ago representatives of *Reader's Digest* asked us to study the mineral content of vegetables from various parts of the United States. After a conference on the matter, it was decided to put a capable man into the field to collect 200 samples of snapbeans, cabbage, tomatoes, and spinach from 10 states, including Georgia, South Carolina, Virginia, Maryland, New Jersey, New York (Long Island), Ohio, Indiana, Illinois, and Colorado. The soils of these states represented the badly leached coastal-plain areas of the south, and east, the more nearly neutral areas of the north central region, and the alkaline irrigated areas of the west.

(Continued on page 28)

Annual Meeting of American Plant Food Council at Bretton Woods, N. H.

Clifton A. Woodrum, president of the American Plant Food Council, has announced that the organization's fourth annual convention will be held at The Mount Washington Hotel, Bretton Woods, New Hampshire, June 19th to 22nd.

"An outstanding program is being arranged, including addresses from nationally-known leaders in the fields of agricultural education and research," Mr. Woodrum said.

"The Mount Washington Hotel, located on a beautiful 10,000-acre estate in northern New Hampshire, can accommodate 500 guests and has all the facilities for a successful convention, both from a business as well as a recreational standpoint."

J. A. Howell, executive vice president of the Virginia-Carolina Chemical Corp., Richmond, Va., is chairman of the Convention Committee which includes C. B. Robertson, president of Robertson Chemical Corp., Norfolk, Va., and Fred J. Woods, vice president of Gulf Fertilizer Company, Tampa, Fla.

St. Regis Opens New Kraft Paper Mill

St. Regis Paper Company announces the bringing into production of a new kraft paper mill at Tacoma, Wash. This just about completes the current phase of the company's broad program of integration, modernization and expansion.

Part of the pulp manufactured by St. Regis at its Tacoma sulphate pulp mill will now be converted into paper at Tacoma and then into multiwall paper bags in the company's western factories, to meet the mounting industrial packaging needs of the Pacific Coast. To round out the integration, the company acquired during the past several years substantial timber resources in the Northwestern area.

Commenced late in 1947, the new kraft paper mill at Tacoma houses a Pusey & Jones Fourdrinier paper machine designed to produce multiwall kraft paper 168 inches wide at a rate of 2100 feet per minute. This represents a capacity to produce 240 tons of this type of paper every 24 hours.

In announcing the selection of Tacoma as the site for the company's eighth kraft paper mill, Roy K. Ferguson, St. Regis' president, said: "The city was chosen because it offered an exceptional combination of geographical and industrial advantages which would make possible a completely integrated operation on the Pacific Coast."

Heretofore, the sulphate pulp of the company's Tacoma pulp mill has been sold as market pulp or converted at other kraft paper mills of the company. With the completion of the new paper mill, part of the pulp will be converted at Tacoma, with the balance still available for the company's pulp customers.

"Pioneers of Fertility"

An interesting book on the beginnings of soil science has been produced by Imperial Chemical Industries Limited, of London, England. Entitled "Pioneers of Fertility," this volume of 125 pages tells the story of 22 men in Great Britain who led the world along the path to better farming. Starting with Fitzherbert of Norbury who wrote "The Boke of Husbandry" in 1523, the brief biographies of forward-looking farmers and scientists through the succeeding centuries give a graphic picture of the development of agriculture into a science.

The book is priced at 10 shillings and is being sold by the *Fertilizer Journal Ltd.*, 110 Cannon St., London, E.C.4, England.

November Sulphate of Ammonia

Production of by-product sulphate of ammonia during November continued at about the same rate as preceding months, according to the U. S. Bureau of Mines. A total of 70,859 tons was produced during that month, compared with 71,002 tons during October. In addition, 3,024 tons were produced from purchased synthetic ammonia. Shipments during November were about 3800 tons less than production and stocks on hand at producing plants on November 30th had increased to 28,053 tons.

	Sulphate of Ammonia Tons	Ammonia Liquor Tons NH_3
Production		
November, 1948	70,859	2,068
October, 1948	71,002	2,186
November, 1947	69,827	2,098
Jan.–Nov., 1948	756,711	22,626
Jan.–Nov., 1947	737,203	23,499
Shipments		
November, 1948	67,011	1,437
October, 1948	73,023	1,416
November, 1947	68,555	1,913
Stocks on Hand		
Nov. 30, 1948	28,053	543
Oct. 31, 1948	24,476	582
Nov. 30, 1947	32,241	793

The Fate of Phosphate Soil Supplements

By JACKSON B. HESTER

(Continued from the issue of December 25, 1948)

Drainage and Microbiological Activities

For a number of years it has been observed that plants in poorly drained areas in the field are spindly in nature and look like plants starved of phosphorus, even though phosphate supplements have been used. During 1947 in the tomato growing section around Chatham, Canada and Toledo, Ohio on the Brookston clay loams and similar soils following heavy rainfall in the spring and puddled soil conditions, many crops showed signs of phosphorus deficiency. Since fields that were thoroughly cultivated recovered rapidly, laboratory experiments were carried out with the idea of ascertaining information on this subject. Upon submerging (*9*) the soils which had an almost neutral *p*H value for about two weeks under anaerobic conditions, relatively large amounts of ferric and ferrous iron came into solution. This is illustrated in Table VI.

TABLE VI

WATER SOLUBLE IRON* IN SUBMERGED SOIL BROOKSTON CLAY LOAM

Soil Horizon	Ferric Iron	Ferrous Iron
A_p	12 ± 5	24 ± 9
B	6 ± 1	21 ± 9

*Parts per million in the soil (mean of 24 samples, pH 6.7 – 7.2)

Here it is shown that from 6 to 24 parts per million of ferric and ferrous iron were in solution at a given point in the procedure. This would mean that there would be no phosphorus in solution under similar conditions. Consequently, under field conditions, if the soils were compact and water-logged a similar condition might occur. Because of this fact, time and temperature (*2*, *5*) is important.

Time and Temperature

Time is a very important factor in crop production. In other words, certain crops must be started early in the spring in order for them to mature before frost. Temperature hastens chemical reactions according to certain laws. Therefore, in the spring of the year if the soil is wet and water-logged, as the temperature increases, the reaction of the solubility of iron and alumnium and the precipitation of phosphates increases, thus delaying progress of the crop. The above discussion naturally leads to the amount and composition of phosphate supplements.

Amount and Composition of Phosphates

From the theoretical standpoint it is interesting indeed to study, under sand and

(Continued on page 24)

TABLE VII

THE AVAILABILITY OF DIFFERENT PHOSPHATE COMPOUNDS IN SAND CULTURE

Phosphate Compounds (c. p.)*	Milligrams P_2O_5 Absorbed per Pot***					Yield in Grams Dry Weight***				
	Sweet Corn	Collards	Tomatoes	Potatoes	Lima Beans	Sweet Corn	Collards	Tomatoes	Potatoes	Lima Beans
Ferrous	4.84	0.0	0.0	0.0	0.23	1.2	0.0	0.0	0.0	0.4
Ferric	3.97	12.14	1.46	14.14	51.79	2.4	1.7	1.1	3.2	11.0
Aluminum	18.90	22.76	24.00	89.83	98.15	6.4	3.0	4.3	10.9	19.5
Manganese	10.06	0.0	83.94	122.32	0.0	3.0	****	11.5	16.5	0.0
Tri-calcium	18.90	52.71	145.26	110.61	87.30	6.4	5.4	14.5	18.9	24.2
Tri-magnesium	21.76	59.39	301.13	320.42	319.59	7.5	4.6	18.9	20.7	35.7
Di-calcium	23.84	82.11	296.13	302.36	307.15	8.3	7.0	21.0	22.6	35.0
Di-magnesium	22.54	88.90	320.91	407.44	371.53	7.8	8.0	12.2	26.7	30.3
Rock Phosphate**	3.59	1.91	5.05	31.18	33.83	0.9	0.3	0.1	1.8	8.0

*Chemically pure. 1 gram of P_2O_5 added per pot to washed beach sand.
**Commercial.
***Phosphorus absorbed and yields in check pots subtracted.
****Toxicity from soluble manganese.

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Principal Articles in This Issue

TVA Not Aiding Lower Fertilizer Costs

A report, issued recently by the Select Committee on Small Business appointed by the House of Representatives, states that their investigations have failed to find that TVA fertilizer operations have aided in the cheapening of production of fertilizer and fertilizer materials.

During the Fall of 1947 and the Spring of 1948 the small business committee received numerous complaints respecting the distribution and sale of fertilizers manufactured by the TVA. It was charged that aside from the fertilizers distributed for use in tests and demonstrations, and small sales to Federal agencies, the balance of TVA's fertilizer production was being distributed exclusively through cooperatives and other favored outlets.

It was pointed out in several complaints that since the cooperatives pay no Federal taxes, this method of distributing a product, the manufacture of which was made possible only by a huge investment of tax money, was grossly unfair and discriminatory to the tax-paying private producers of fertilizer.

Paul O. Peters, investigator for the committee, made an examination of the books and accounting records of the TVA pertaining to operations of the chemical plants. He found that published statements respecting the operation of these plants for the fiscal years 1946 and 1947 showed net expenses for 1946 of $868,055, and for 1947 of $1,430,834.

These expenses were incurred as follows:—The total operating expenses for the fiscal year 1947 were $15,409,373; total income from sales to cooperatives and others amounted to $11,510,904; fertilizers used in tests and demonstation cost $2,431,366; chemical products used in other TVA activities cost $36,269; leaving $1,430,834 of the operating expense to be met from other income to TVA or from operated funds.

Mr. Peters said that by strict commerical standards TVA's chemical plant operations were conducted at almost a $4,000,000 loss in 1947. However, the loss which in this instance is called "net expense" was accounted for in the services rendered through experimental work and the contribution of fertilizers for tests and demonstrations. He said that in balancing the books TVA accountants indulged in practices which would not be countenanced in private industry.

TVA was charged by Congress "to utilize the Muscle Shoals properties as far as may be

necessary to improve, increase, and cheapen the production of fertilizer and fertilizer ingredients," Mr. Peters said. In so doing, TVA was authorized to use any process or processes that in its judgment appeared wise and profitable for the fixation of atmospheric nitrogen.

"It cannot be shown from the record that TVA has achieved the objectives in cheapening the process for producing ammonium nitrate," he stated.

As to superphosphate, Mr. Peters added: "During World War II, while fertilizers were being requisitioned from both private industry and TVA for shipment abroad under the lend-lease programs, private industry operating under OPA supplied triple superphosphate f.o.b. Tennessee production points at 75 cents per unit of P_2O_5, while at the same time Treasury Procurement Division, was billed as high as $1.01 per unit by TVA.

"It is concluded, therefore, that TVA has not substantially contributed to cheapening the production of fertilizer and fertilizer ingredients."

With respect to the charges made that TVA fertilizers, in excess of quantities used in tests and demonstrations, and quantities requisitioned by Federal agencies, were being distributed exclusively to cooperatives and other favored outlets, Mr. Peters said that a list of consignees to whom TVA products were shipped during the fiscal year 1947 appears to substantiate these charges.

He also cited a letter which TVA had sent to a member of Congress complaining about its distribution methods in which TVA said that it was aware of some deficiencies in its distribution arrangements, namely, the problem of serving farmers who are not members of the cooperatives, but that it had been unable to devise a more effective method of distribution.

Arthur M. Smith Joins Mathieson Staff

Dr. Arthur M. Smith, formerly Vice-President and Technical Director of Synthetic Nitrogen Products Corporation, has joined the market research staff of Mathieson Chemical Corporation, according to Thomas S. Nichols, president. A major share of Dr. Smith's time will be devoted to nitrogen applications in behalf of the company's ammonia department.

Dr. Smith is a pioneer in the introduction of synthetic ammonia fertilizers in the United States and through factory research has developed satisfactory methods for mixing synthetic ammonia fertilizers with superphosphate.

A graduate of Pennsylvania State College, Dr. Smith received his M.S. and Ph.D. degrees from the University of Maryland. He served the Universities of Illinois and Florida as Agronomist and Chemist and then returned to the University of Maryland as Associate Professor of Soils and Soil Chemist of the Agricultural Experiment Station.

V-C Appoints Myron Keim to Research Staff

Virginia-Carolina Chemical Corporation has announced the appointment of Myron M. Keim of Des Moines, Iowa, as Midwestern Agronomist, effective January 1.

A native of Nebraska, Mr. Keim is the son of a Master Farmer and received his degree in agronomy from the University of Nebraska, College of Agriculture, in 1938. He then accepted a soybean fellowship for graduate work in agronomy at Rutgers University, New Brunswick, New Jersey, and received his Masters Degree in 1940.

During the war, Mr. Keim served with the Chemical Division of the War Production Board in Washington, D. C., and later with the American Potash Institute, as economist and statistician. More recently he was associated with the Potash Company of America as field representative in the West North Central States.

Wilkins Retires from Chase Bag Company

The retirement of Ernest L. Wilkins, whose broad experience in the bag industry began with Chase Bag Company in 1906, has been announced by R. N. Conners, Chase Vice-President and General Sales Manager. Mr. Wilkins' retirement became effective December 31st after 42 years of service in the Company's Specialty Division where he began as Factory Superintendent and later became manager of the Chase Goshen branch. At retirement, Mr. Wilkins was in charge of Specialty Sales at the Goshen factory, a position he has held since 1941.

During his many years with Chase, Mr. Wilkins became known as one of the industry's most informed packaging experts in the produce and chemical fields. He was instrumental in introducing the now popular open mesh bag for fresh fruits and vegetables to growers and shippers throughout the country.

Salter Reviews New Production Technology

Changes in crop production methods resulting from the practical use of technology on American farms are emphasized in the annual report of the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, just issued. Dr. Robert M. Salter, chief of that Bureau, says that farmers are producing their crops more efficiently and more economically through extensive use of research results.

Modern scientific farming, in many instances, represents the actual "payoff" on research that has been carried on over a period of many years, Dr. Salter says. These are the dividends to the nation from its investment in agricultural research.

Dr. Salter reviews progress of the past decade in improving methods for controlling weeds and plant pests, advances with fertilizers, and the discovery of new research tools. He also summarizes progress of the last year on numerous specific research projects.

Weeds are being controlled more efficiently on farms and ranches with new supplemental methods that employ petroleum derivatives, plant growth regulators, and other chemicals. Hundreds of new chemicals are still being tested for their weed killing action, according to the report, and many appear promising.

Farmers are more effectively protecting their crops against damage from insects, fungi, and nematodes with newly developed compounds. Their widespread use has been promoted through new and improved methods of spraying, dusting, and fumigating.

Newly developed fertilizer technology has gained widespread acceptance during the last 10 years as farmers doubled their use of commercial fertilizers. Plant foods are being put into the soil in greater concentrations and in new forms with new and improved equipment. Fertilizers are now being applied in granular, liquid, and gas forms.

A large measure of the credit for new discoveries is attributed by the bureau chief to the operation of cooperative research that make it possible for thousands of scientists throughout the nation to work together as a team.

Dr. Salter's report covers many advances in various fields of experimentation—in crops and their management, soil research, and agricultural engineering. He describes a new tomato variety that combines resistance to fusarium wilt and collar rot with tolerance of late blight, a new blackberry especially adapted for freezing developed for the Pacific Northwest, and a recently introduced strawberry variety that has taken over in the coastal region of the Carolinas. He tells about storing Easter lilies at lower temperatures to improve blooming, and shortcut methods of soil fumigation for nematode control.

The bureau plant breeders, in cooperation with State workers, have developed new Hessian fly resistant winter wheat varieties, a new type of buckwheat that promises greater yields of rutin, a new low-coumarin variety of sweetclover, new Burley tobacco varieties that increase the percentage of cigarette leaf without reducing yield, new strains of long-staple cotton, and a higher yielding hybrid sugar beet resistant to leaf spot.

Scientists of the bureau have developed a new method of propagating elm trees resistant to Dutch elm disease that will make it possible soon to release stock to the public.

Soil research revealed that maximum yields in the Columbia River Basin can be obtained with the best combination of the various factors affecting plant growth, and that organic matter and nitrogen are of increasing importance in dry areas. Improved methods

(Continued on page 26)

FERTILIZER MATERIALS MARKET

NEW YORK

Shipments of Chemical Nitrogen on Schedule but Demand Still Greater Than Supply. Some Price Advances in Nitrogen Solutions. Increased Feed Buying Raises Organics Prices. Superphosphate in Adequate Supply for All Current Demands. Potash Situation Improving

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, January 5, 1949.

Sulphate of Ammonia

Demand continued excellent from various sections and shipments were running on schedule. Some material was being exported under Government direction.

Nitrogen Solutions

Some price advances were made by certain producers, effective January 1st, but the demand is still so heavy this will have little effect on buying. Some quarters report shipments coming through a little faster.

Nitrogenous Tankage

Demand was reported poor for this material although a large part of the estimated production is under contract. Some lower prices were reported but could not be confirmed.

Castor Pomace

Some material was sold at $24.00 per ton, f.o.b. production points, as demand for quick shipment eased somewhat. The available supply is not large and it is thought that as soon as the heavy shipping season starts, the demand will increase considerably.

Hoof Meal

On account of the small available supply, this material remained firm in price and several sales were reported at $7.00 per unit of ammonia, ($8.51 per unit N), f.o.b. various shipping points.

Organics

Packing house by-products remained steady in price with the turn of the year as various large feed interests re-entered the market and bought available supplies at steady prices. Blood continued to sell in small lots at $10.00 per unit of ammonia ($12.15 per unit N) and in large lots at $9.50 ($11.55 per unit N) f.o.b. various shipping points with very little material available. Tankage sold at $9.00 per unit of ammonia ($10.94 per unit N) with some sales at slightly lower prices. Vegetable meals sold down and then recovered as new buying entered the market. Linseed meal was firm and supplies for nearby shipment hard to obtain. Cottonseed meal was said to be well sold up for quick shipment.

Fish Meal

Some material was available at Atlantic Coast points but most fish factories were closed for the season. Some offerings for foreign fish meal were reported but the quality was said to be poor. Last sales of fish meal were made at $145.00 per ton, f.o.b. fish factories.

Bone Meal

This is one fertilizer material that is not only hard to buy for quick shipment but the price keeps going up. This situation is caused by the heavy demand from the feed trade who at the present time are taking the greater part of the shipments.

Superphosphate

While triple superphosphate was still in considerable demand, regular superphosphate was easily obtainable at prevailing market prices and no shortage was looked for during the next few months. Some export business was reported.

Potash

Demand for this material has eased somewhat in the last month and producers are shipping as fast as production facilities permit. A better balance for this material is looked for during the coming year.

CHARLESTON

Farmers Slow in Ordering Fertilizers. No Improvement in Nitrogen Supply. Potash Shipments on Schedule. Superphosphate Adequate.

Exclusive Correspondence to "The American Fertilizer"

CHARLESTON, January 3, 1949.

Mineral nitrogen continues short of demand. Movement of potash to consumers continues on schedule but still short of demand. Superphosphate continues in adequate supply. The fertilizer manufacturers in most states are rather worried about the delayed call by farmers for fertilizers as it will mean a shorter shipping period when the full demand materializes. This will cause production difficulties.

Organics.—Organics continue to draw practically no interest from the fertilizer trade and as a result of withdrawal of support by the feed trade, tankage dropped recently in price 50 cents per unit of ammonia.(61 cents per unit N). Practically no business has been done on imported organics, due to the high prices asked.

Castor Pomace.—The market is nominally $27.50 per ton in bags, f.o.b. eastern production point, and movement is primarily against existing contracts.

Dried Ground Blood.—The supply situation is tight in the New York area with the market around $9.50 to $9.75 ($11.55 to $11.85 per unit N). The Chicago market is also approximately $9.50 to $9.75 in bulk; the lower price being for prompt shipment and the higher price for deferred shipment. Little interest is shown by the fertilizer trade.

Potash. — Shipments have been steady against contracts for the past month and no stocks have been able to accumulate at the mines. Demand continues strong with no change in price indicated by the producers.

Phosphate Rock.—For the past month demand and supply have been in balance. Prices have been steady.

Superphosphate.—Stocks continue adequate to meet mixers requirements; October production being approximately four per cent above September's output. Triple superphosphate continues tight with demand in excess of supply.

Sulphate of Ammonia.—Production during October was up by approximately 5,000 tons over September, being approximately the same output as compared to October of last year. The market continues definitely tight with all producers' expected supplies sold well ahead.

Ammonium Nitrate.—Demand continues far in excess of supply, maintaining the market in tight position. No recent change in price has been announced.

Nitrate of Soda.—The market is firm with prices unchanged. Supply continues inadequate to meet the entire demand.

PHILADELPHIA

Higher Nitrogen Prices Fail to Lower Demand. Superphosphate Supplies Ample for Present. Foreign Potash Offerings Increasing.

Exclusive Correspondence to "The American Fertilizer"

PHILADELPHIA, January 3, 1949.

Nitrogenous materials continue in scarce supply, with prices higher than last season, but the demand at present not so keen. Consumer demand is currently very quiet.

Sulphate of Ammonia.—Production is sold well ahead and the market is exceedingly tight. Resale material is practically unobtainable.

Nitrate of Soda.—Market continues strong with prices unchanged, and material in far less supply than demand.

Ammonium Nitrate. — While production shows improvement, the supply is entirely inadequate to meet requirements.

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IN INDIA . . . 350,000 tons a year of ammonium sulfate will be produced by a plant at Sindri to be operated by the Indian government.

IN EGYPT . . . every day 550 tons of calcium nitrate will flow from the great plant at Suez . . . to be built for the Societe Egyptienne d'Engrais et d'Industrie Chimiques (S. A. E.).

IN MEXICO . . . 70,000 tons of low-cost ammonium sulfate will flow from a new plant near Mexico City to be built for Guanos y Fertilizantes S. A., Mexico's leading fertilizer manufacturer.

In other strategic places throughout the world—as well as in the United States—Chemico is helping to meet the need not only for fertilizer, but also for sulfuric acid, synthetic ammonia, synthetic methanol and other heavy chemicals.

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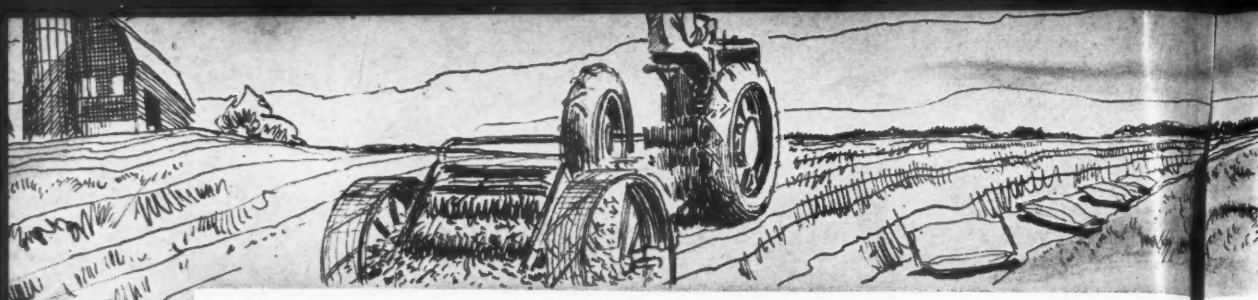

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Castor Pomace.—This article is still being moved out only on contracts and no new offerings at this time.

Blood, Tankage, Bone.—The organics market has eased off somewhat due to lack of interest by the feeding trade. However, blood is quoted at $10.00 per unit of ammonia ($12.15 per unit N) in New York, and $9.50 ($11.55 per unit N) in Chicago for early shipment is practically unobtainable.

Fish Scrap.—Menhaden meal is higher at $145.00 for 60 per cent protein, and $150.00 for 65 per cent. Scrap has been quoted at $135.00 to $137.50 per ton.

Phosphate Rock.—Market remains normal with prices unchanged, and production fully up to requirements.

Superphosphate. — No price changes reported, and production is quite able to meet the demand.

Potash.—Shipments are moving on contracts and up to schedule. Demand for domestic keeps well ahead of supply even though offerings from Europe are becoming quite numerous.

CHICAGO

Feed Material Demand Takes All Supplies and Prices Continue Strong

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, January 5, 1949.

The demand for feeding materials still keeps up with production. Meat scraps sold at outside points at $112.50 per ton.

Digester tankage sold at $124.00 per ton and some are asking as high as $128.00. Dry rendered tankage sold at $1.85 per unit of protein at some points and $1.95 at other points. Some sold also at $2.00 delivered.

A price of $9.50 ($11.55 per unit N) is bid for dried blood and $9.75 ($11.85 per unit N) is asked for deferred delivery.

No sales reported on wet rendered tankage. The market is nominally $9.50 per unit of ammonia ($11.55 per unit N).

There is very little steamed bone meal or raw bone meal moving. Prices are unchanged at $65.00 to $70.00 per ton, the latter price being closest to the market.

Bayne Succeeds Scott as Bemis Kansas City Plant Manager

Clyde F. Scott, manager of the Bemis Bro. Bag Co. Kansas City plant for thirty years and a member of the company's board of directors since 1926, has announced his retirement effective last January 1. He is succeeded as manager at Kansas City by Howard L. Bayne.

Mr. Scott joined Bemis at Kansas City in 1904 in the order department, later became city salesman and assistant to the manager, and was appointed manager in 1918. He is a member of the Kansas City Chamber of Commerce and the Central Industrial District Association, of which he is a past-president and now a director.

Mr. Scott will continue his long association with the Bemis Company by remaining as a senior counselor, but asked that he be relieved of more active duties to enable him to devote some of his time to travel.

Mr. Bayne joined Bemis as a salesman in 1912 and has been assistant manager at Kansas City since 1923.

Pennsylvania Orchard Fertility Experiment Discussed

Writing in *Science for the Farmer*, March, 1948, Professor Frank N. Fagan reviews the history of the Pennsylvania orchard fertility plots. In discussing complete fertilizer for apple trees, he emphasized the need for feeding cover crops. According to Fagan, the College Orchard experiments started in 1908 indicate that yields of many commercial apple orchards in this State could be doubled through proper soil management and fertilization practices. Two ideas are basic in orchard soil management: (1) Before real

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response can be expected from mineral fertilizers, the soil must be in a physical condition suited to tree growth; (2) No single plant-food element is the key to continued tree growth and yield, and no two soils will respond exactly alike to elements applied. In summarizing the results of this test over the 40-year period, Fagan points out that an annual per-acre broadcast application of 150 pounds of nitrate of soda, 150 pounds of superphosphate, and 30 pounds of muriate of potash was made. Further, it is believed that other soil types may require even more of each of the major elements and a 1–1–1 ratio probably is a safe recommendation for most orchards. Sufficient lime should be used at all times to insure growth of legume cover crops.

Coleman Urges Early Buying of Fertilizers

To help to promote the early movement of fertilizers from manufacturing plant to the farm, Dr. Russell Coleman, president of the National Fertilizer Association, has written to directors of State Extension Services, asking their cooperation.

"The fertilizer industry," wrote Dr. Coleman, "U.S.D.A. and State officials for several years have advised farmers of the importance of ordering their fertilizer supplies early and of storing them in dry places for use the following season.

"Despite the fact that some fertilizers are still scarce and that there may not be enough to meet everyone's requirements next spring, the simple fact confronts us that the storage capacities of most fertilizer plants are now sorely overtaxed. Only when the fertilizer now stored in these plants is moved can more be produced to meet demands.

"It is highly important that everyone concerned, particularly persons in your key positions, urge farmers to act now in helping to move finished goods out of fertilizer plants."

Wisconsin Pasture Fertilizer Profitable

The use of commercial fertilizers has been profitable on 95 per cent of the field trials conducted by the Soils Department of the University of Wisconsin. When the carry-over effects on hay crops is added to the increased production from the grain crops, the results from 119 plots over an eleven-year period

show returns over fertilizer costs that are startling.

During the eleven-year period yields secured on the 119 plots showed a return of $9.96 per acre over fertilizer costs from an application of 200 pounds of 0–20–0. The average yield per acre on these plots was 51.7 bushels of grain and 4,477 pounds of hay. This was an increase of 1,048 pounds of hay over those plots not receiving the fertilizer.

A return of $14.28 per acre was secured from an application of 200 pounds of 0–20–10 with the hay yield being 1,649 pounds greater than the check plots receiving no fertilizer.

Hoard's Dairyman.

THE FATE OF PHOSPHATE SOIL SUPPLEMENTS

(Continued from page 11)

soil culture, the influence of the various forms of phosphorus upon the availability of these phosphates to plants. Table VII shows the availability of equal amounts of phosphorus (*14*) from phosphatic compounds upon the growth of sweet corn, collards, tomatoes, potatoes, and lima beans in sand culture and the absorption of phosphorus by the same crops. In other words, collards, tomatoes, potatoes, and lima beans absorbed no ferrous phosphate while sweet corn absorbed some phosphate from all sources. However, collards, tomatoes, potatoes, and lima beans absorbed much more phosphorus from the readily soluble sources of phosphorus than sweet corn. It is interesting to note that finely ground rock phosphate has a low availability of phosphorus to all crops except potatoes and lima beans. Manganese phosphate was toxic to lima beans and collards, but available to tomatoes and potatoes. It should be borne in mind, however, that the readily available soluble calcium and magnesium phosphates produced the maximum crop in all cases. This supports the fact that soils with optimum *p*H values and replaceable calcium and magnesium are important soils from the standpoint of availability of phosphorus. This clearly shows that the crops used to test the availability of phosphorus in the soil give different availability rates for various compounds.

Crop Rotation and Test Crops Used

Under similar conditions the above illustrations show that crops like sweet corn absorb less phosphorus in making a unit growth than crops like collards. It is also evident that the larger the amount of yield of the particular plant concerned, the larger the amount of phosphorus required for its production. The illustration in Table VIII shows the relation of a limed soil to an acid soil upon the availability of various phosphatic compounds to lima beans. In other words, under acid conditions, compounds like ferric phosphate have some availability whereas on limed soils it has no availability. It must not be inferred that compounds of pure iron, aluminum, and calcium phosphates occur in the soil, because actually they undoubtedly occur as complicated colloidal phosphates like iron and aluminum silicate phosphates, etc. There is undoubtedly competition for the active iron and aluminum ions between phosphates, silicates, and humates (*20, 21*), ultimately forming the more stable compounds. Under anaerobic conditions undoubtedly the ferrous phosphate compound is one of the more stable compounds. This is all very important from the standpoint of crop rotation because if a big

TABLE VIII

THE INFLUENCE OF HYDRATED CALCIUM LIME UPON THE AVAILABILITY OF DIFFERENT COMPOUNDS IN A NORFOLK SANDY LOAM

Phosphate Compounds	Milligrams P_2O_5 Absorbed*		Increase in Yield* Dry Weight	
	Acid Soil**	Limed Soil	Acid Soil	Limed Soil
Ferrous	0.0	0.0	0.5	0.0
Ferric	12.4	0.0	3.7	0.0
Aluminum	6.1	69.9	5.3	1.0
Manganese	0.0	74.8	0.0	7.1
Tri-Calcium	43.3	23.5	13.2	0.0
Tri-Magnesium	21.8	113.4	10.2	3.9
Di-Calcium	39.2	38.2	14.0	0.0
Di-Magnesium	62.9	43.5	15.5	0.4
Superphosphate	143.2	142.9	16.5	12.5

*Phosphorus absorbed and yields in check pots subtracted. Yield of check 51.7 and 61.7 grams of dry matter for the limed and unlimed pots respectively.

**pH 4.6 for acid soil and pH 6.6 for limed soil—8 kilograms of soil.

crop like corn can be grown upon the soil that is low in phosphorus with nitrogen and potash supplements, undoubtedly utilization of relatively insoluble phosphorus can be made to succeeding crops, provided the crop residue is returned to the soil.

It has been shown that the A_p horizon of soils in the old fertilized areas of the Coastal Plain have been increased in total phosphorus from 10 to 20 times the original found, yet many of these same soils respond to phosphate supplements for certain crops such as spinach, beans, collards, kale, etc. This indicates that phosphatic supplements are being changed to the more difficultly available phosphatic compounds in the soil. Crop rotation, soil reaction, replaceable bases, organic matter, clay content, and phosphatic compounds in the soil are important factors in the availability of the phosphorus present and the supplemental applications of phosphates to the soil. In view of the above facts it is not likely that the soils will become saturated with phosphorus, but will respond to supplemental applications for many years to come.

References

1. Buehrer, T. F. 1932. The physico-chemical relationships of soil phosphates. Ariz. Agr. Exp. Sta. Tech. Bul. 42.
2. Dean, L. A. 1934. Electrodialysis as a means of studying the nature of soil phosphates. Soil Sci. 37:253–266.
3. Heck, A. Floyd. 1934. Phosphate fixation and penetration in soils. Soil Sci. 37:343–355.
4. Heck, A. Floyd. 1934. Effect of the degree of base saturation of a soil on its capacity to fix phosphorus in difficultly available form. Soil Sci. 38:463–470.
5. Heck, A. Floyd. 1934. A method for determining the capacity of a soil to fix phosphorus in difficultly available form. Soil Sci. 37:477–482.
6. Hester, Jackson B. 1933. Interrelation of electrokinetic behavior and cation exchange of iron phosphate. Jour. Amer. Chem. Soc. 55:1442.
7. Hester, Jackson B. 1935. The amphoteric nature of three Coastal Plain soils: I. In relation to plant growth. Soil Sci. 39:237–246.
8. Hester, Jackson B. 1937. The influence of phosphate fertilization upon the amphoteric properties of Coastal Plain soils. Jour. Amer. Soc. Agron. 29:10–16.
9. Hester, Jackson B. and F. A. Shelton. 1947. Solubility of iron in submerged soils. Science 106:595.
10. Hester, Jackson B. 1945. Fundamental studies on some tomato producing soils. Campbell Soup Co. Res. Mono. 1.
11. Hester, Jackson B. and F. A. Shelton. 1934. Comparative data for three Coastal Plain soils for soil characteristics and plant growth. Va. Truck Exp. Sta. Bul. 84.
12. Hester, Jackson B. and F. A. Shelton. 1937. The results of long-time fertilization and cropping practices upon the chemical and physical composition of Coastal Plain soils. Proc. Soil. Sci. 2:201–205.
13. Hester, Jackson B. and F. A. Shelton. 1939. Geographical location and soil organic matter. Jour. Amer. Soc. Agron. 31:598–603.
14. Hester, Jackson B., J. M. Blume, and F. A. Shelton. 1937. Rapid chemical tests for Coastal Plain soils. Va. Truck. Exp. Sta. Bul. 95.
15. McGeorge, W. T. and J. F. Breazeale. 1932. Studies in iron, aluminum, and organic phosphates and phosphate fixation in calcareous soils. Ariz. Exp. Sta. Tech. Bul. 40.
16. Marbut, C. F. 1935. Atlas of American Agriculture: III. Soils of the United States. U.S.D.A.
17. Mattson, Sante and Jackson B. Hester. 1932. The laws of soil colloidal behavior: X. Exchange neutrality and combining capacity. Soil Sci. 34:459–483.
18. Mattson, Sante and Jackson B. Hester. 1935. The laws of soil colloidal behavior: XV. The degradation and the regeneration of the soil complex. Soil Sci. 39:75–84.
19. Mattson, Sante and Nils Karlsson. 1938. The electro-chemistry of soil formation: II. The phosphate complex. Annals Agr. College Sweden 6:109–157.
20. Robinson, W. O. and R. S. Holmes. 1924. The chemical composition of soil colloids. U.S.D.A. Bul. 1311.
21. Scarseth, G. D. and J. W. Tidmore. 1934. The fixation of phosphates by clay soils. Jour. Amer. Soc. Agron. 26:152–162.
22. Scarseth, G. D. and J. W. Tidmore. 1934. The fixation of phosphates by soil colloids. Jour. Amer. Soc. Agron. 26:138–151.

SALTER REVIEWS NEW PRODUCTION TECHNOLOGY

(Continued from page 14)

have been developed for rapidly diagnosing alkali soils, and methods have been devised and equipment assembled for the manufacture of several different radioactive fertilizers used in tracer experiments.

Advances reported on engineering phases of the bureau's work include new principles applicable in farm-size milk pasteurizers, a new method of lint flue cleaning for removing fine trash from cotton lint in the ginning process, and improvements in equipment for harvesting and drying ramie and kenaf fiber. Other engineering studies have demonstrated that arrangement and construction of dairy barns can reduce labor costs, that hog gains are affected by temperature and humidity and that alfalfa hay barn-cured with supplemental heat has more food value than field-cured hay.

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The brokerage firm of Scar-Lipman & Co. has moved its offices to larger quarters in the Empire State Building, 350 Fifth Ave., New York City. This company handles foreign and domestic fertilizer materials and chemicals.

MINOR ELEMENTS IN SOILS AND PLANTS

(Continued from page 9)

As the samples were received they were immediately put through a drying and pulverizing process and then sent through a streamlined laboratory procedure for 12 elements, including Ca, Mg, K, Na, P, B, Mn, Fe, Cu, Zn, Co, and Mo. The analysis showed that the total mineral content of these vegetables increased from south to north and from east to west. Of special interest to this discussion was the finding that the percentages of most of the minor nutrient elements increased from east to west. But there were three exceptions. The percentages of Mn and Na tended to be higher in the east than in the west, and the content of Zn tended to increase from north to south.

One of the practical conclusions which might be drawn from these studies, as they apply to the needs of man, is that it is fortunate that the several foods which we consume come from such widely separated areas, with their great diversity of soils. Thus the deficiencies of one area and the possible excesses of another tend to balance each other. It also suggests that the city dweller may be better nourished as to mineral elements than the farmer's family, whose food is more largely the produce of a particular farm and soil. It also makes it even more apparent that livestock which consumes feed that is entirely derived from one farm is more likely to suffer from mineral deficiencies than is the average man. The same applies to plant life in that its mineral nourishment comes entirely from the soil on which it grows. But fertilizers and manures often materially improve the situation for plants.

We now know that large areas of land in New Jersey, as well as in many other states, are deficient in one or another or several of the minor nutrient elements. Thus it is common practice to add about 5 pounds of borax to each ton of fertilizer, and use is made of about 25 pounds of additional borax per acre annually for certain crops, like alfalfa, that have relatively high boron requirements. It has been found advisable to add about 40 pounds of available magnesium to each ton of fertilizer that is used on the sweet and white potatoes that are grown on unlimed soils of the coastal plain. It is now standard practice to add 50 pounds of manganese sulfate per acre annually to intensively-farmed market-garden soils of the state that have been overlimed. Vegetable growers who are located on the peat soils of New Jersey use about 50 pounds of copper sulfate per acre every second or third year.

Unfortunately, we are much better informed about what to do when certain well-known deficiency symptoms become apparent on crop plants than we are about why these elements are needed by plants and animals. In other words, it is important that a great deal more work be done to determine more exactly the function or functions in living things of a considerable number of minor nutrient elements, including not only those already mentioned, but such others as may later be proven to be essential.

We would like very much to study a considerable number of plants with respect to variations in content of these two-valence elements under controlled conditions of growth After selecting from among these plants such of them as seem especially responsive to some one or more of these elements, we would then like to study them in solution culture under conditions of varying concentrations and ratios of these elements. An effort would be made to relate the elements to the plants' oxidase-reductase and other enzyme systems. It is possible that each of these elements has specific functions, that two or more of them have additive values in one or more functions, or that they may severally balance each other in a given system. Consideration in like manner will also be given to certain of the better-known soil microorganisms.

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CYANAMID
American Agricultural Chemical Co., New York City
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City

DRYERS
Sackett & Sons Co., The A. J., Baltimore, Md.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Titlestad Corporation, Nicolay, New York City

FERTILIZER (Mixed) MANUFACTURERS
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Davison Chemical Corporation, Baltimore, Md.
International Minerals & Chemical Corporation, Chicago, Ill.
Southern States Phosphate & Fertilizer Co., Savannah, Ga.
Virginia-Carolina Chemical Corp., Richmond, Va.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
Jackle, Frank R., New York City
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Machine Works, Aurora, Ind.

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Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Southern States Phosphate & Fertilizer Co., Savannah, Ga.
Woodward & Dickerson, Inc., Philadelphia, Pa.

INSECTICIDES
American Agricultural Chemical Co., New York City

LEAD BURNERS
Southern Lead Burning Co., Atlanta, Ga.

LIMESTONE
American Agricultural Chemical Co., New York City
Ashcraft-Wilkinson Co., Atlanta, Ga.
McIver & Son, Alex. M., Charleston, S. C.

LOADERS—Car and Wagon
Hough Co., The Frank G., Libertyville, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making and Handling
Atlanta Utility Works, The, East Point, Ga.
Chemical Construction Corp., New York City
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Ammoniating
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, The, East Point, Ga.
Baughman Manufacturing Co., Jerseyville, Ill.
Hough Co., The Frank G., Libertyville, Ill.
Hayward Company, The, New York City
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, The, East Point, Ga.
Bradley Pulverizer Co., Allentown, Pa.
Kent Mill Co., Brooklyn, N. Y.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Material Handling
Atlanta Utility Works, The, East Point, Ga.
Baughman Manufacturing Co., Jerseyville, Ill.
Hayward Company, The, New York City
Hough Co., The Frank G., Libertyville, Ill.
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Mixing, Screening and Bagging
Atlanta Utility Works, The, East Point, Ga.
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Power Transmission
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Superphosphate Manufacturing
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MANGANESE SULPHATE
McIver & Son, Alex. M., Charleston, S. C.

MINOR ELEMENTS
Tennessee Corporation, Atlanta, Ga.

MIXERS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

NITRATE OF SODA
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.

NITROGEN SOLUTIONS
Lion Oil Company, El Dorado, Ark.
Spencer Chemical Co., Kansas City, Mo.

NITROGENOUS ORGANIC MATERIAL
American Agriculture Chemical Co., New York City
Armour Fertiliz Works, Atlanta, Ga.
Ashcraft-Wilkins , Atlanta, Ga.
Baker & Bro., H New York City
Davidson Comm sion Co., The, Chicago, Ill.
Huber & Company, New York City
International Min als & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

NOZZLES—Spray
Monarch Mfg. Works, Philadelphia, Pa.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Virginia-Carolina Chemical Corp., Richmond, Va.

PLANT CONSTRUCTION—Fertilizer and Acid
Atlanta Utility Works, The, East Point, Ga.
Chemical Construction Corp., New York City
Monsanto Chemical Co., St. Louis, Mo.
Sackett & Sons Co., The A. J., Baltimore, Md.
Southern Lead Burning Co., Atlanta, Ga.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Titlestad Corporation, Nicolay, New York City

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City

POTASH SALTS—Manufacturers
American Potash and Chem. Corp., New York City
Potash Co. of America, New York City
International Minerals & Chemical Corporation, Chicago, Ill
United States Potash Co., New York City

PRINTING PRESSES—Bag
Schmutz Mfg. Co., Louisville, Ky.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.

REPAIR PARTS AND CASTINGS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

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SCALES—Including Automatic Bagging
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Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SCREENS
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Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind
Sturtevant Mill Company, Boston, Mass.

SEPARATORS—Air
Kent Mill Co., Brooklyn, N. Y.
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
Jackle, Frank R., New York City
McIver & Son, Alex. M., Charleston,
Woodward & Dickerson, Inc., Philade a. Pa.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.

SULPHURIC ACID
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Southern States Phosphate Fertilizer Co., Savannah, Ga.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, G.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davison Chemical Corporation, Baltimore, Md.
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City
Southern States Phosphate Fertilizer Co., Savannah, Ga.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Minerals & Chemical Corporation, Chicago, Ill.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

TAGS
Keener Mfg. Co., Lancaster, Pa.

TANKAGE
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davidson Commission Co., The, Chicago, Ill.
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

VALVES
Atlanta Utility Works, The, East Point, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

Alphabetical List of Advertisers

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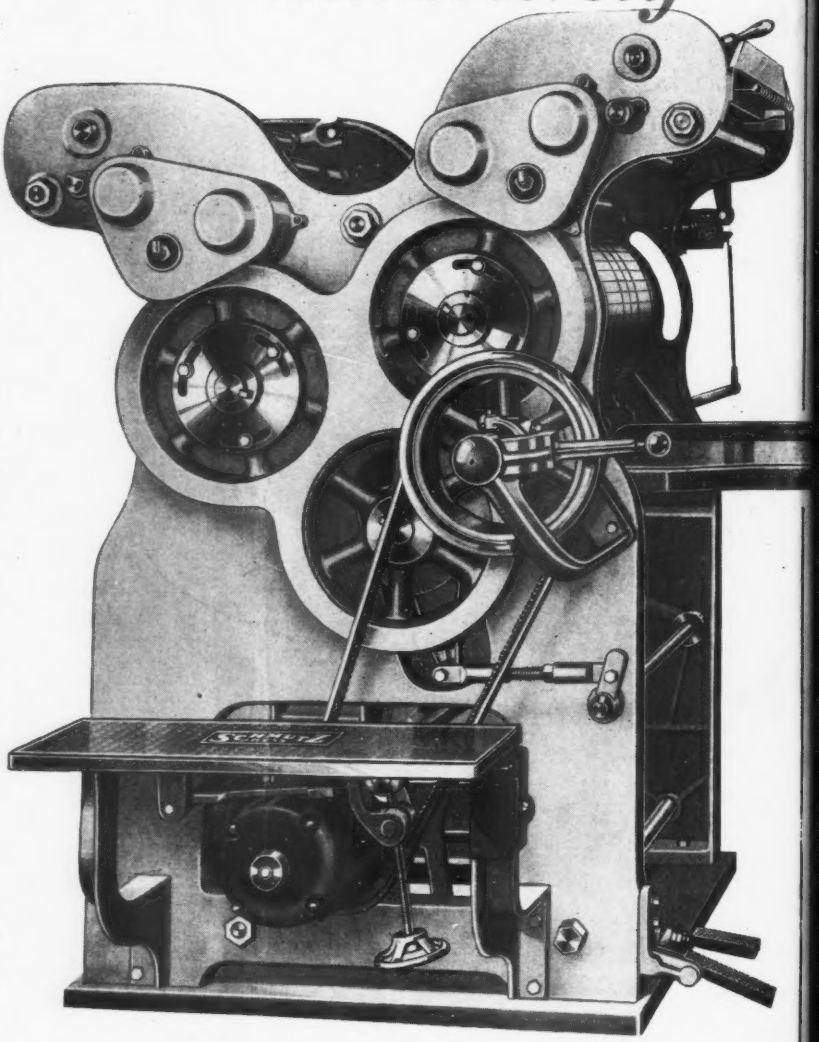

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